987,116

PATENT SPECIFICATION

DRAWINGS ATTACHED

987.116

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Date of filing Complete Specification: March 28, 1961.

Application Date: June 29, 1960. No. 22802/60.

Complete Specification Published: March 24, 1965.

Index at acceptance:—B6 A(21D3, 22D3, 22H); B3 E(1A, 1G, 1L, 10C1, 10C2, 10C5, 10D1); B8 A(6CU, 6P)

Int. Cl.:—B 42 c // B 23 k, B 65 g

COMPLETE SPECIFICATION

Improvements in or relating to Bookbinding

We, JAMES BURN AND COMPANY LIMITED, a British Company of 32/38 Saffron Hill, Holborn, London, E.C.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to bookbinding.

More specifically, it is concerned with the performance of the actual binding operation in the system of binding known as the WIRE-O (Registered Trade Mark) system using binding elements as hereafter defined.

In the WIRE-O binding system, sheets perforated close to one of their edges are bound by a binding element of the type consisting of a continuous length of wire which has been bent so that at regular intervals along its length it has projecting laterally from it curved prongs in the form of hairpins of which the closed ends lie just within or adjacent to the open ends. In order that the sheets may be mounted on the prongs, the latter are initially brought into an intermediate or half-closed position in which there is a substantial gap between their closed and open ends and in which, in side elevation, they have the shape of a C or, preferably a Greek E, that is to say, a C with a re-entrant kink in its back (*e*). When the sheets have been mounted on the prongs in that condition, the prongs are bent so as to close the gap between their open and closed ends whereupon the sheets are held against removal from them.

The operation of mounting the sheets on the prongs of the half-closed binding element is normally effected by hand and the closing of the prongs is effected in a press while the operator holds the sheets. The operators who do this work become very skilled but in spite of the digital dexterity which they acquire, the mounting operation is laborious and lengthy and significantly affects the cost of the finished product, particularly when the elements are of small capacity, that is to say, can be used for the binding of only a small number of sheets.

This invention is concerned with the mechanisation of the mounting operation.

It comprises a machine having means for receiving the binding elements with their prongs in the half-closed position and means for conveying the elements one by one transversely of their length to a binding station at which there is a press, a table for receiving a packet of perforated sheets to be bound having their perforations disposed between the jaws of the press and means for orientating and holding each element as it arrives at the binding station with the closed ends of its prongs so directed that on closing the jaws of the press, those ends are brought into or close to the open ends of the prongs and, while being so brought, are caused to pass through the perforations in the sheets.

Preferably, the machine has means which, as each element reaches the binding station, displaces the element at right angles to its direction of movement towards that station into the path of action of means for moving it into its final position between the jaws of the press. In general, the elements will be conveyed horizontally and the foremost element will be displaced upwards so as to be brought opposite a member mounted for horizontal reciprocation towards and away from the binding station and having projecting from its forward face tongues which, during the forward movement of the member become engaged in the prongs of the lifted element and hold that element by friction when it is no longer supported by the lifting means.

For ease of handling, the elements are most advantageously assembled to form a "mat" by being mounted on "sticks" in the from of strips lying on edge parallel to each other and straddled by the prongs of the elements so that these are frictionally held on the strips. Such a mat can be fed into the machine and the elements be brought successively to the binding station by the conveying means pro-

[F]

vided in the machine which act on the sticks so as to feed the mat forward intermittently.

The sticks can be strips of cardboard intended to be thrown away after one use but they can, instead, be made of a more durable material such as a plastic which enables them to be used repeatedly. The sticks can be rigid or flexible. If flexible, they can be made of great length and be wound off a drum at the back of the machine and be re-wound on to a drum after passing through the binding station. Alternatively, they can be endless and pass round rollers disposed at opposite sides of the binding station.

The elements can be mounted on the sticks when the latter are disposed in the machine or the mats can be pre-formed and be brought to the machine as such. If the sticks are sufficiently flexible they can, after the elements have been mounted on them, be wound into the form of a roll which can then be unwound as a mat of great length. Such a mat roll forms the subject of our Application No. 51960/64 (Serial No. 987,117) and constitutes a very convenient means of storing and transporting a large number of binding elements which are ultimately to be fed to the binding machine.

In order that the invention may be thoroughly understood, an example of a machine in accordance with it will now be described with reference to Figures 1—11 of the drawings accompanying the Provisional Specification, and Figures 12—14 accompanying this Complete Specification, of which:—

Figure 1 is a perspective view of a WIRE-O binding element partly in the half closed condition and partly in the closed position;

Figure 2 is a plan view of a mat of half-closed elements;

Figure 3 is a section taken on the line III—III in Figure 2 and showing certain parts of the machine diagrammatically;

Figures 4—8 are identical cross-sections through parts of the machine showing five successive phases of its operation;

Figure 9 is a view of a detail taken in the direction of the arrow A in Figure 8;

Figures 10, 11, 13 and 14 show alternative forms of mats, and

Figure 12 is a detail to a larger scale with the parts in the position shown in Figure 6.

As clearly seen in Figure 1, each of the binding elements 10 is formed of a continuous length of wire which has been bent so that at regular intervals along it it has projecting laterally from it curved prongs 12 which are separated by straight lengths 13 and which, if flat, would be in the form of hairpins having a closed end 14 and an open end 15. In the ready-for-use condition shown in the left-hand part of Figure 1, the prongs are in a half-closed position, there being a substantial gap between their open and closed ends. In the final condition shown on the right in Figure 1, the prongs are fully closed, their closed ends 14 having been brought just into the open ends 15. It will be appreciated that perforated sheets impaled on the half-closed prongs 12 will be permanently retained thereon when the prongs are closed. The peculiar shape given to the half-closed prongs which have a kink 16 in their back is an expedient which is designed to ensure that the prongs close to a reasonably accurate circular shape. The two halves of a prong on either side of the kink are substantially semi-circular and if the prongs are closed in a press, they tend to hinge about the kink.

In the machine about to be described, the perforated sheets are not placed on the prongs before the prongs are closed as is the case when they are manually mounted. Instead, they are placed in such a position that during the prong closing operation, the closed ends 14 of the prongs are caused to pass through the perforations of a stack of sheets.

To prepare the elements for being fed to the machine, they can be formed into a mat 20 as shown in Figures 2 and 3. It will be seen therein, that each element is laid across a pair of strips or "sticks" 18 of cardboard, plastic or the like lying on edge parallel to each other so that the hairpin legs of selected prongs 12 straddle and laterally grip the sticks. When a number of elements have been so mounted on the sticks, there is formed a mat 20 which can be handled without fear of disintegration but from which any element and particularly an end element 10 can be picked with ease.

As shown in Figures 4—8, the machine is formed so as to receive a mat 20 of binding elements 10 and convey the mat through the machine intermittently to and through a binding station at which there is a press having a pair of jaws 22, 23 which can be moved towards each other so as to complete the closing of the half-closed prongs of any element which lies between them. As will be described in detail, the machine has means for picking-off the foremost element from the mat without disturbing its neighbour and bringing it, properly orientated, into the path of action of a member which moves it into position between the jaws of the press.

At the back of the machine, there is a feed table 24 arranged to receive a mat 20 the sticks 18 of which are bare of binding elements at the front end. These bare ends pass through the machine into the range of action of a gripper 26 which is operable to grip those ends and to pull the mat forward as will be explained in greater detail further on. By this operation, the foremost element on the mat is brought into the position shown in Figure 4 in which it is ready for use.

At the binding station shown in Figures 4—8, there are, along the length of the machine a number of stop pins 28 which are shown in their normal, inoperative position in Figure 8. When the mat has been brought

into the position shown in Figure 4, these stop pins 28 are raised as shown in that Figure so as to lie between the foremost element 10 and that immediately behind it. They lie opposite the straight lengths of wire 13 between the prongs of the latter element as indicated in Figures 2 and 3 and thus prevent the lower part of the element from being moved forward out of the position shown in Figure 4 when the element in front of it is removed from the mat.

The next operation is to lift the foremost element 10 off its sticks 18. This is done by raising a lift pad 30 into the position shown in Figure 5. The lift pad is grooved so that in rising it does not lift the sticks of the mat. The element is thus lifted into contact with an upper, spring-loaded pressure pad 31 so that when it finds itself in the position shown in Figure 5 in which it is off the sticks 18, it is firmly held in the grip of the two pads 30, 31. It is then at the level of the gap between the press jaws 22, 23.

While the element is being so lifted, vertical ribs or tongues 33 on the forward end of a back feed tool 32 become engaged in its prongs as shown in Figure 5. The tongues are a friction fit in the prongs so that they can hold the element in the elevated position when the lift pad 30 is lowered. That having been done, accompanied by lifting of the pressure pad 31, the gripper 26 is operated so as to pull the mat forward by its sticks 18 at the same time as the back feed tool 32 is advanced. The latter has, depending from its lower side, a pair of latches 34, 35 pivotally mounted at 36 as shown somewhat diagrammatically in Figure 3. The upper latch 34 which is spring-loaded is located within the two hairpin legs of the prongs 12 of the elements forming the mat and its forward end abuts against the closed end of that prong (see Figure 2) which is in the foremost position on the mat when an element has been lifted off the mat as in Figure 5. The lower latch 35 is located between neighbouring prongs 12 and its forward end abuts against the straight lengths of wire 13 between these prongs as shown in Figure 2. Therefore, when the back feed tool 32 is advanced, the latches 34, 35 push forward the foremost element on the mat at the same time as the sticks 18 are being pulled forward by the gripper 26. The latches 34, 35 thus hold the foremost element against displacement, by tilting or otherwise, relatively to the sticks 18. At the same time, the elevated element is brought out of the position shown in Figure 5 into the gap between the jaws 22, 23 as shown in Figure 6 and is held by the latches at a slightly lower level than it was held by the pad 32 so that the base of the element contacts the upper face of the lower press jaw 22. That element is now ready to be closed, being held against all undesirable movement, its back being supported by the tool 32 and the closed ends 14 of its prongs resting against a locator 39 at the front.

Before the closing is effected, the packet of perforated sheets to be bound is placed on the front table 37, 38 as shown in Figure 12 so that it rests on the portions 13 of the element which lie between the prongs. The downwardly sloping front face of the locator 36 assists in guiding the sheets into the right position. The tongues 33 on the front end of the back feed tool act as back gauges for the location of the sheets. Lateral registration is ensured by a side gauge on the table 38.

For effecting the closing of the prongs, the lower jaw 22 of the press is lifted carrying the rear part 38 of the front table with it as shown in Figure 7 while the locator 36 is lifted. The lower half of each prong substantially maintains its position relatively to the jaw 22 but the upper half is swung down and, in so doing, its closed end 14 (Figure 1) is caused to pass through the perforations in the sheets and into the vicinity of the open end 15 (Figures 1 and 7). The stack of sheets is thus bound.

It remains then only to lower the lower press jaw 22, remove the bound package and restore the parts to the normal inoperative positions shown in Figure 8 whereupon the cycle described above can be repeated to bind a new packet of sheets with the now foremost element of the mat.

The various operations described above are performed by cams (not shown) on a cam shaft 40. The machine is preferably arranged for semi-automatic operation, an operator being provided who controls the cam-shaft through a pedal. It can be contrived that a first pressure on the pedal causes the cam shaft to turn through half a revolution so as to bring the parts from the positions of Figure 8 through those of Figures 4 and 5 to those of Figure 6 and a second pressure causes the cam shaft to turn through the remaining half revolution to perform the binding operation illustrated in Figure 7 and restore the parts to the positions of Figure 8, the operator placing the sheets in the binding position between the two actuations of the pedal and removing them at will after the binding operation has been effected.

A fragmentary side elevation of the gripper 26 taken in the direction of the arrow A in Figure 8 is shown in Figure 9. The gripper has two parts 42, 43. The part 42 has in it slots 44 in which are engaged the sticks 18 of the mat. The part 43 is formed with teeth 45 and is mounted for movement relatively to the part 42 as indicated by the arrow in Figure 9. When the mat is to be advanced, the part 43 is moved to the right (Figure 9) so that the sticks 18 become gripped between the teeth 45 and one side of the slots 44. Thereupon, the gripper is turned on its pivot 46 (Figures 4—8), after which the part 43 is moved to the

left (Figure 9) to release the sticks and the gripper is swung back to its original position.

It is most important that the elements be held accurately from the moment they come under the influence of the various tools. Slight inaccuracies can cause jams. The stop pins 28, the latches 34, 35 and the other positioning and orientating parts are therefore very important parts of the machine.

Figures 10 and 13 show an alternative form of mat capable of carrying a very large number of binding elements. Here, the "sticks" 18 are very long lengths of a flexible plastic which can be easily twisted through 90°. The binding elements are mounted on two or more of these strips lying on edge and parallel to each other in the same way as they are mounted on the more rigid sticks 18 of Figures 2—8 to form a very long mat which can be rolled up on a centre or former 50 as shown in Figure 10. When the binding elements are to be used, the rolled-up mat is placed behind the machine and the strips 18 which are bare of elements at their outer ends are threaded through the machine. At their exit from the machine, they are passed through a guide 52 which turns them through 90° to enable them to be wound in the flat condition on a take-up centre or former 54. The binding process proceeds as described above.

The rolled-up mat in which the plastic or other flexible element-carrying strips are used, simplifies the problem of feeding the machine for long-run operation, that is to say, for binding a very large number of identical packages. It also simplifies storage and transportation of the binding elements. One package can be made to contain a number of elements of the order of 20,000. In order to avoid the possibility of interference between the convolutions during unwinding, the convolutions can be interleaved with paper.

Figures 11 and 14 show a mat 20 which is fed with binding elements by hand. The sticks 18 are here in the form of endless strips or belts of flexible material which are tensioned on a pair of intermittenly rotated drums 56 on which they lie flat. Between the two drums, the upper runs of the strips pass through a pair of guides 58 which turn them through 90° in opposite directions. The lengths between the two guides are therefore on-edge and can receive binding elements to form a continuously replenished mat comparable with those described above.

WHAT WE CLAIM IS:—

1. A bookbinding machine having means for receiving binding elements (of the type defined herein) with their prongs in the half-closed position and means for conveying the elements one by one transversely to their length to a binding station at which there is a press, a table for receiving a packet of perforated sheets to be bound with their perforations disposed between the jaws of the press and means for orientating and holding each element as it arrives at the binding station with the closed ends of its prongs so directed that on closing the jaws of the press those ends are brought into the vicinity of the open ends of the prongs and, while being so brought, are caused to pass through the perforations in the sheets.

2. A bookbinding machine according to claim 1 having means which, as each element reaches the binding station, displace it at right angles to its direction of movement towards that station into the path of action of means for moving it into its final position between the jaws of the press.

3. A bookbinding machine according to claim 2 having means which, in conjunction with the said displacing means, hold the displaced element appropriately orientated while it is being engaged by the means which move it into its final position.

4. A bookbinding machine according to claim 2 or claim 3 in which the means for moving the displaced element into its final position are adapted so as to hold the element frictionally held on the strips, in which the means are restored to their inoperative position.

5. A bookbinding machine according to claim 4 in which the means for moving the displaced element into its final position comprise a member mounted for reciprocation at right angles to the length of the element and having tongues projecting from its front face which are frictionally engageable in the prongs of the element.

6. A bookbinding machine according to any preceding claim in which the binding elements are presented to the press with the closed ends of their prongs projecting forwardly and downwardly so that the perforated sheets to be bound are laid on the prong connecting pieces of the element.

7. A bookbinding machine according to any preceding claim adapted for the conveyance of the elements to the binding station in the form of a mat comprising a number of "sticks" in the form of strips lying on edge parallel to each other and straddled by the prongs of the elements so that the elements are frictionally held on the strips, in which the conveying means are adapted to act on the sticks so as to feed the mat forward intermittently and bring the elements one by one to the binding station.

8. A bookbinding machine according to claims 2 and 7 in which the means for displacing the forward element on its reaching the binding station act to remove that element from the sticks while other means hold the neighbouring element on the mat against movement with or by the displaced element.

9. A boodbinding machine according to claim 7 in which the mat is spirally wound into the form of a roll with the elements lying parallel to the axis of the roll.

10. A bookbinding machine according to claim 9 having, beyond the binding station, means for turning the strips from the edge-on position to the flat position and winding them into the form of rolls.

11. A bookbinding machine according to any one of claims 1—8, in which the means for conveying the elements to the binding station comprise a number of endless strips of flexible material passing round rollers disposed on either side of the binding station and having means which, before the strips reach the binding station, turn them from the flat to the edge-on position so that they can receive the binding elements.

12. A bookbinding machine substantially as described with reference to the accompanying drawings and the drawings accompanying the Provisional specification.

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Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press (Leamington) Ltd.—1965. Published by The Patent Office, 25 Southampton Buildings, London, W.C.2, from which copies may be obtained.

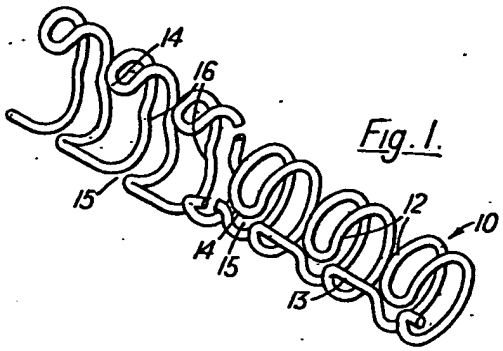

Fig. 1.

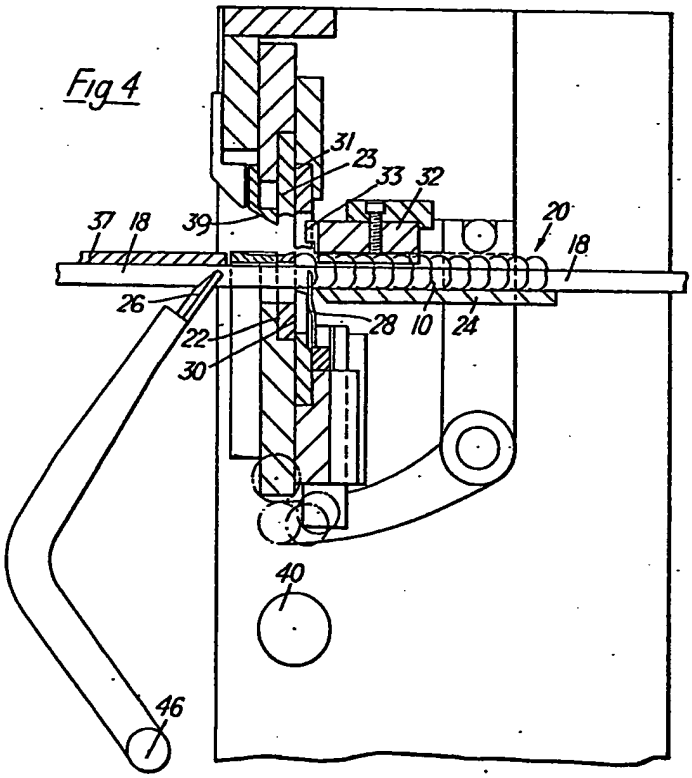

Fig 4

33

I

III

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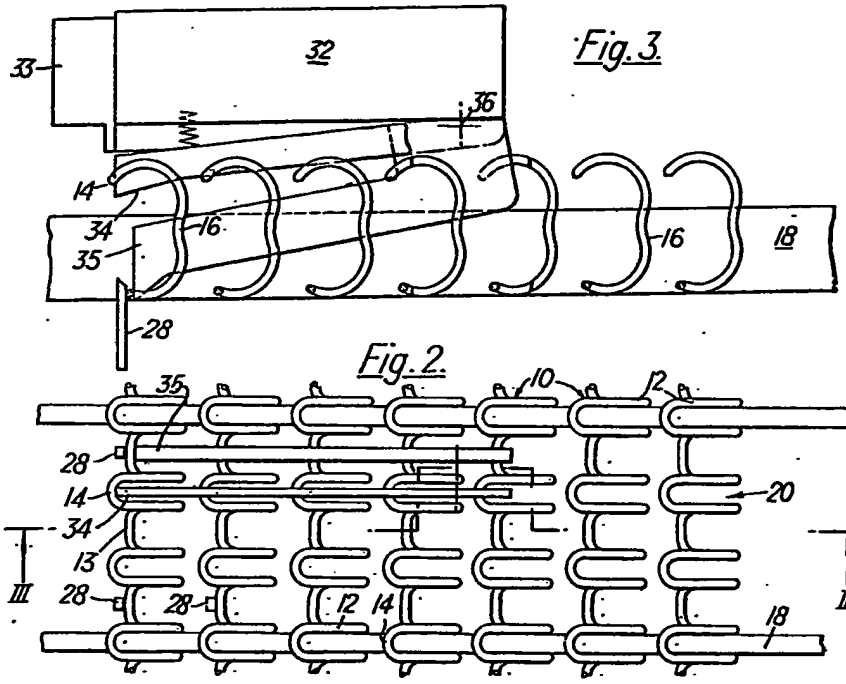

Fig. 3.

Fig. 2.

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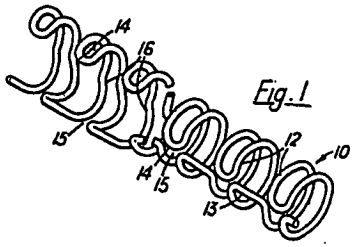

Fig. 1

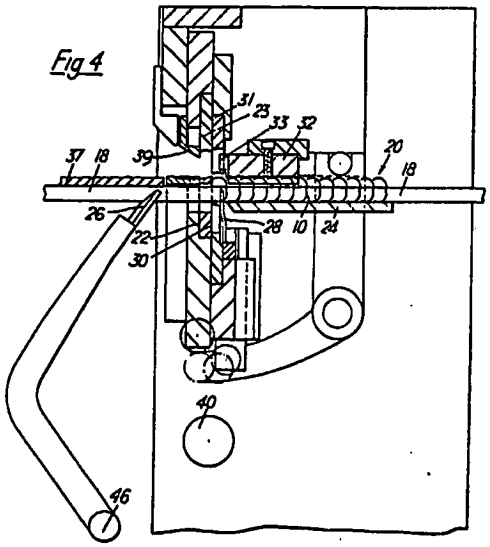

Fig 4

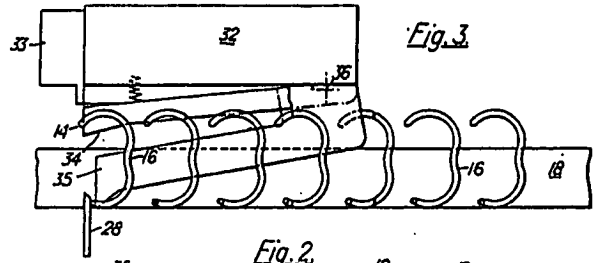

Fig. 3

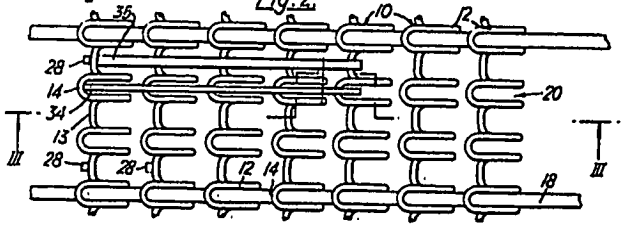

Fig. 2

Fig. 5.

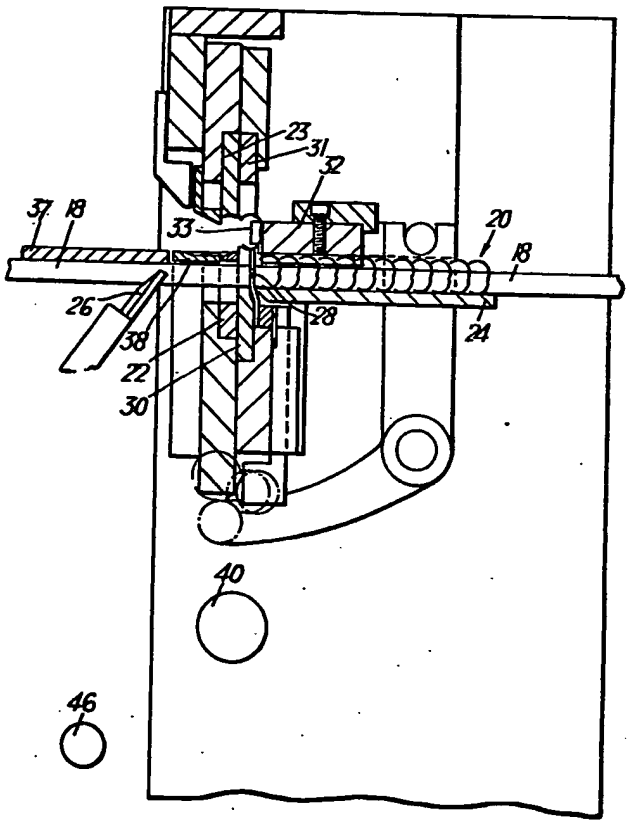

Fig. 6.

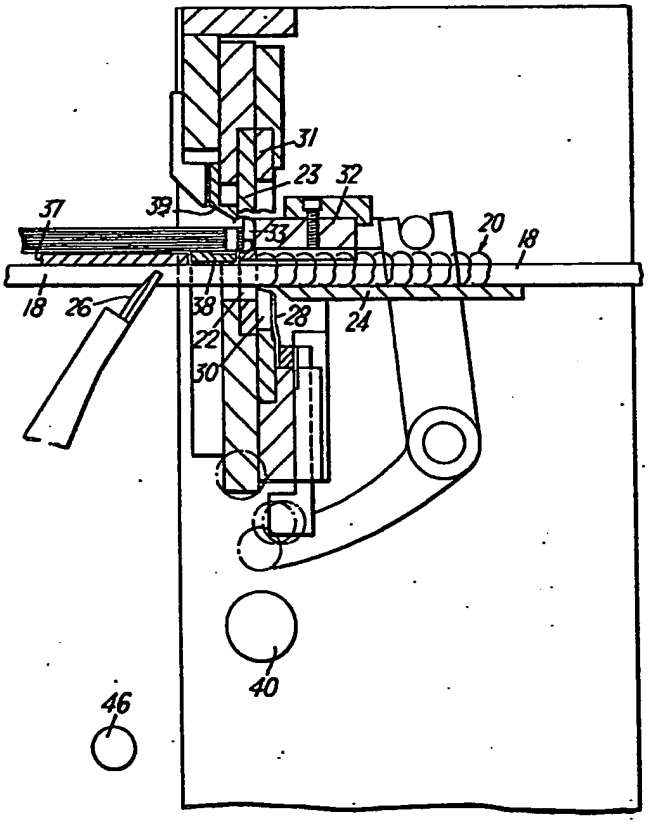

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Fig. 7.

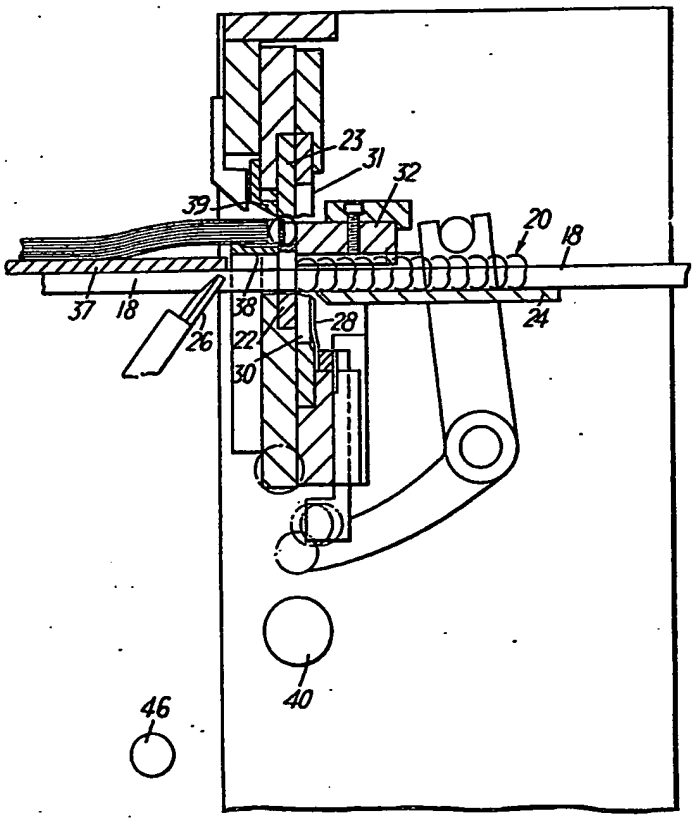

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Fig. 6.

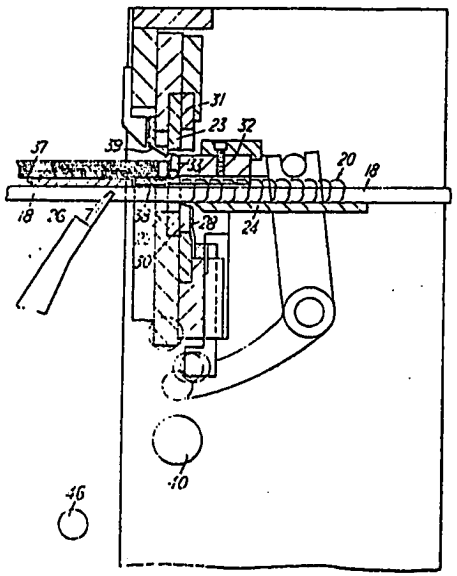

Fig. 7.

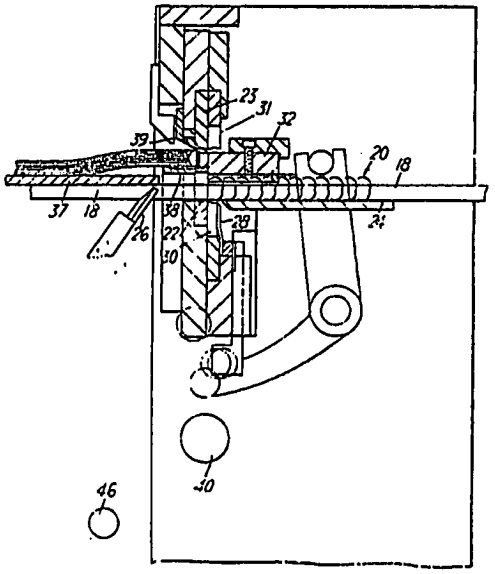

Fig. 8

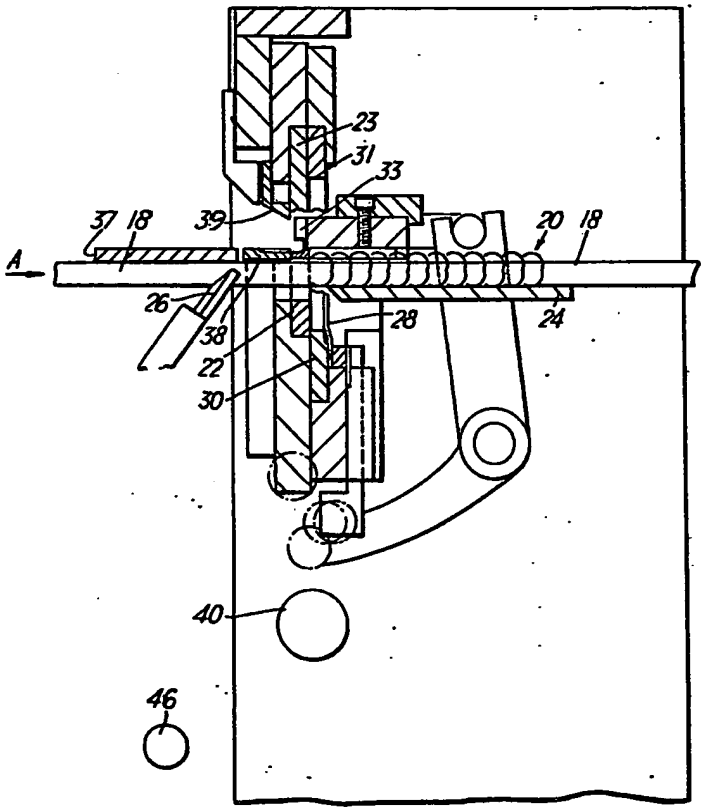

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Fig.9.

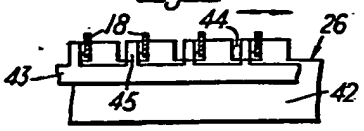

Fig.10.

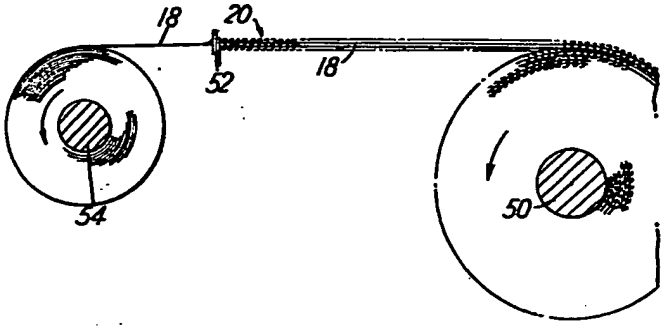

Fig.11.

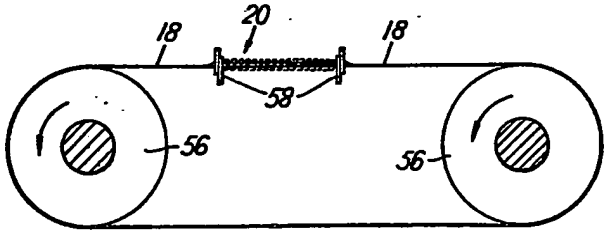

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Fig.8

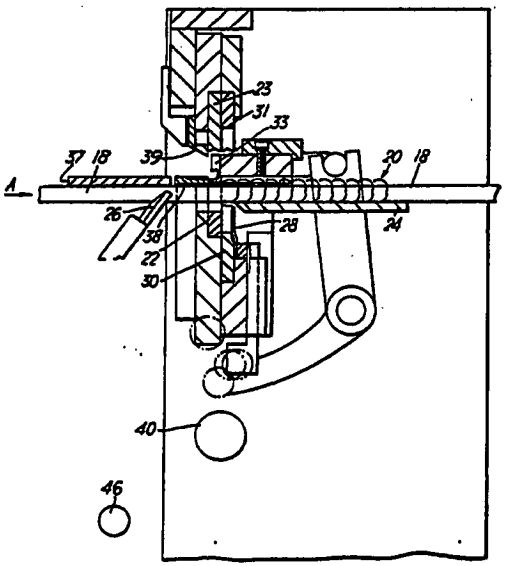


Fig.9.

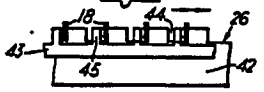


Fig.10.

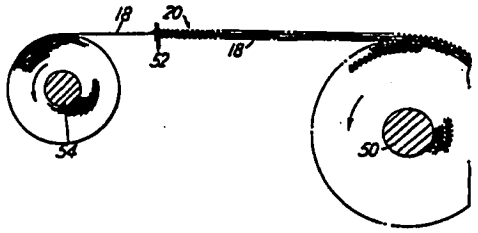


Fig.11.

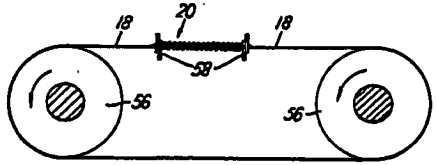
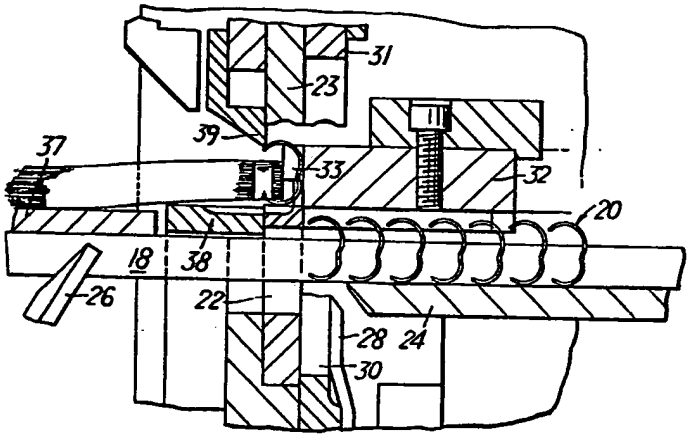


Fig. 12.



987116 COMPLETE SPECIFICATION

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Sheets 1 & 2

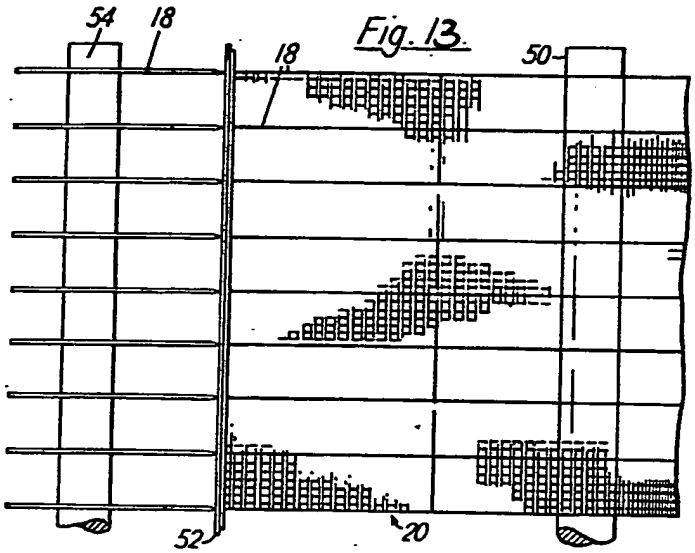

Fig. 13.

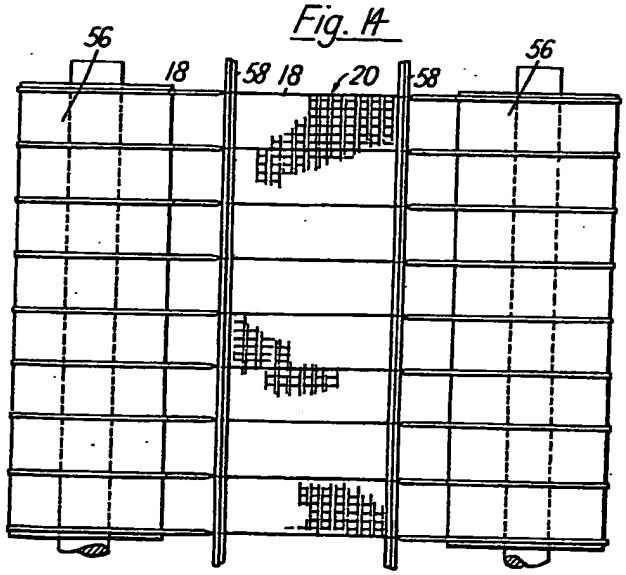

Fig. 14

987116 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

Fig. 12.

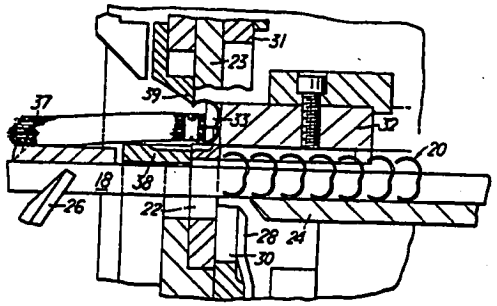

Fig. 13.

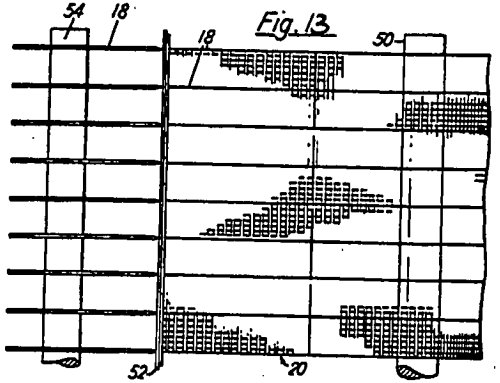

Fig. 14